

Appl. No. : 10/692,243
Filed : October 22, 2003

REMARKS

Claims 1-11 are pending in the present application and stand rejected on a variety of grounds. Claims 1, 8 and 10 have been amended. Applicants respectfully request entry of the amendments and full consideration of the remarks contained herein.

Amendments to the Claims

Applicants have amended the claims to correct various obvious clerical errors. For example, independent Claim 1 has been amended to recite “atomic hydrogen” rather than “hydrogen atoms” to conform terminology in that claim to the terminology in Claims 6-7; independent Claim 1 now recites, *inter alia*, “exposing the part, coated with the first reactant to atomic hydrogen, wherein the atomic hydrogen reduces the first reactant on the part to silicon.” Claims 8 and 10 have been amended to recite “atomic oxygen” rather than “oxygen atoms” to conform terminology in that claim to the terminology in Claim 11; Claim 1 now recites, *inter alia*, “exposing the part coated with the first reactant to atomic oxygen, wherein the atomic oxygen converts the first reactant on the part to silicon dioxide.” As the amendments merely correct obvious clerical errors to better conform the claim terminology of various claims to one another, Applicants respectfully submit that the amendments add no new matter and are fully supported by the application as originally filed.

No New Issues

As noted above, the amendments to the claims merely correct obvious clerical errors by conforming terms in certain of the claims with terms in other of the claims. Because the terms, *e.g.*, “atomic hydrogen” and “atomic oxygen,” were present in the claims as filed and have already been searched by the Examiner, Applicants submit that the amendments raise no new issues. Applicants respectfully request entry of the amendments.

Rejections Under 35 U.S.C. § 103

A. Claims 1-7

Claims 1-7 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Sandaresan (U.S. 6,064,077) in view of Bedair (Atomic Layer Epitaxy Deposition Processes) and

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further in view of Faraone *et al.* (U.S. 4,604,304) alone, or further in view of Molsa (Deposition of Cerium Dioxide) and Faraone *et al.* Sandaresan teaches a method of forming silicon dioxide by forming an epitaxial silicon layer and then oxidizing the epitaxial silicon layer. The Examiner has stated that Sandaresan does not teach the recited process to form the epitaxial silicon layer. Bedair has been asserted to satisfy this deficiency by teaching a process in which monolayers of silicon are deposited in a layer-by-layer fashion using dichlorosilane and atomic hydrogen. The Examiner further stated that Sandaresan in view of Bedair does not teach repeating the steps of depositing silicon and oxidizing silicon. Faraone *et al.* alone, or Molsa and Faraone *et al.*, are asserted to satisfy this deficiency by teaching a process in which a silicon oxide layer is efficiently formed by repeatedly depositing and completely oxidizing a silicon layer.

Applicants submit that the pending claims distinguish the art of record.

Initially, Applicants note that it is well-established that a “proposed modification cannot render the prior art unsatisfactory for its intended purpose.” M.P.E.P. § 2143.01(V). In the present case, the Examiner’s asserted modification of Sandaresan would render it unsatisfactory for its intended purpose. Sandaresan discloses a process in which an epitaxial silicon layer 16 is formed to form a transistor. *See* Sandaresan, Figure 2, abstract and Col. 2, lines 20-30. As noted by the Examiner, the epitaxial silicon layer 16 is oxidized to form a gate oxide 18. Significantly, however, Sandaresan teaches a process that only oxidizes a portion of the epitaxial silicon layer 16, since part of that layer must remain epitaxial silicon, to form the channel of the transistor. For example, Sandaresan teaches that the layer 16 is about 500-1000 angstroms thick, but the layer gate oxide 18 is less than 150 angstroms. Sandaresan states:

Layer 16 is preferably grown to a thickness of approximately **500-1000** angstroms, and will contain the **channel** of the field effect transistor to be formed ... a thermal oxidation step is performed to convert a **portion** of the epitaxial layer 16 to gate oxide 18. Gate oxide layer 18 is preferably less than approximately **150** angstroms thick.

See, Col. 2, lines 25-32 (emphasis added). Thus, Sandaresan teaches against completely oxidizing its epitaxial silicon layer 16.

As noted by the Examiner, however, Faraone *et al.* is concerned with efficiently converting a silicon layer into silicon oxide. Faraone *et al.* teaches forming relatively thin silicon

layers to facilitate completely oxidizing those layers, or even extending the oxidation to oxidize the underlying substrate. See Faraone *et al.*, Col. 4, line 36 (“The [silicon] layer was oxidized to **completeness**...”) (emphasis added) and Col. 3, lines 6-16 (teaching forming silicon layers of about 120-400 nm thick, oxidizing those layers and repeating the process a total of three times to form a 1500 nm silicon oxide layer, which is more than three times the largest initial silicon thickness of 400 nm).

As noted above, however, Sandaresan teaches against completely oxidizing its silicon layers, since part of that silicon layer is designed to *retain* its epitaxial silicon, to allow the layer to form both a conductive channel and an insulating gate oxide. Moreover, combining the process of Faraone *et al.* with Sandaresan would result in forming a **completely** oxidized layer, which would be unsatisfactory for its intended purpose of functioning as both a gate oxide and a conductive channel. Molsa also is concerned with forming a complete cerium oxide layer and, in combination with Sandaresan, would likewise render Sandaresan unsatisfactory for its intended purpose. As such, Applicants respectfully submit that the art of record does not establish a *prima facie* case of obviousness; rather, Sandaresan teaches against the asserted combination with Faraone *et al.* and/or Molsa and, if combined with Sandaresan, Faraone *et al.* and/or Molsa would render Sandaresan unsatisfactory for its intended purpose.

Moreover, Applicants note that Sandaresan and Bedair are concerned with forming *epitaxial* silicon layers, which, the skilled artisan will recognize, requires extending the crystallographic ordering of atoms of a particular material up through a layer deposited on the material. The skilled artisan will also understand that oxides are amorphous, non-crystalline materials. See, e.g., Morishita (noting in its introduction that that SiO₂ layers are amorphous). Consequently, once an epitaxial silicon layer is oxidized, that layer becomes non-crystalline and *epitaxial* silicon layer formation does not occur on the oxidized layer, because the amorphous silicon dioxide does not provide a crystal structure to extend. Thus, repeating cycles of forming silicon layers and oxidizing those layers involves depositing the silicon layers over a non-crystalline oxide surface. Given the focus of both Sandaresan and Bedair on forming *epitaxial* silicon layers, the Examiner has not provided any rational for why the skilled artisan would choose to utilize methods directed to epitaxy in a context in which *epitaxial* silicon layer formation does not occur. Applicants submit that the art of record does not satisfy this

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deficiency. Rather, given the focus of Sandaresan and Bedair on epitaxy, Applicants submit that the skilled artisan would not have applied the processes of those references to a process in which non-epitaxial deposition would occur. Thus, for these reasons also, Applicants submit that the art of record does not establish a *prima facie* case of obviousness.

B. Claims 8-11

Claims 8-11 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Bedair in view of Morishita (New Substances for Atomic Layer of Silicon Oxide) and further in view of Faraone *et al.* (U.S. Patent No. 4,604,304); or Bedair in view of Morishita and further in view of Molsa and Faraone *et al.* Bedair has been asserted to teach an ALD process using hydrogen radicals as a reducing agent and Morishita was found to teach ALD processes for depositing silicon dioxide using silicon precursors that comprise oxygen. Faraone *et al.* alone, or Molsa and Faraone *et al.* are asserted to teach repeating depositing silicon and oxidizing.

In response to Applicants' previous arguments that the art of record does not teach or suggest using atomic oxygen as recited in independent Claim 8, the Examiner stated that atomic oxygen was not recited in Claim 8. Claim 8 has now been amended to recite "atomic oxygen." Applicants note that the art of record does not teach or suggest using atomic oxygen to deposit silicon dioxide using a silicon and oxygen containing precursor, as recited in Claim 8. As a result, Applicants submit that the art of record does not establish a *prima facie* case of obviousness.

Accordingly, Applicants respectfully submit that the pending claims are allowable over the art of record. Furthermore, any remarks in support of patentability of one claim should not be imputed to any other claim, and any remarks based on a portion of a claim should not be taken as founding patentability on that portion. Rather, it is intended that patentability rests on the claim as a whole. Furthermore, any such remarks which do not quote the claim portion verbatim should not be used to vary the meaning of the claim, as such are intended as a convenience to improve readability. If not specifically addressed herein, Applicants respectfully traverses each of the Examiner's rejections and assertions as to what the prior art shows or teaches, alone or in combination.

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Moreover, although the present communication includes alterations to the application or claims, or characterizations of claim scope or referenced art, the Applicants are not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. The Applicants reserve the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that the Applicants have made any disclaimers or disavowals of any subject matter supported by the present application.

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CONCLUSIONS

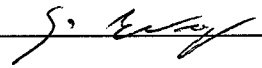
In view of the foregoing, Applicant submits that the application is in condition for allowance and respectfully request the same. If any issue remains which the Examiner feels may be addressed by Examiner's amendment, the Examiner is cordially invited to call the undersigned for authorization.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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Dated: 6/20/07

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